

100Gb/s QSFP28 ER4 Optical Transceiver

100G-Q-ER4

■ Product Features

- ✓ QSFP28 MSA compliant
- ✓ Hot pluggable 38 pin electrical interface 4 LAN-WDM lanes MUX/DEMUX design 4x25G electrical interface
- ✓ Maximum power consumption 5W LC duplex connector
- ✓ Supports 103.125Gb/s aggregate bit rate
- ✓ Up to 40km transmission on single mode fiber without FEC
- ✓ Operating case temperature: 0°C to 70°C
- ✓ Single 3.3V power supply
- ✓ RoHS-6 compliant



■ Applications

- ✓ 100GE Ethernet
- ✓ Data Center Interconnect
- ✓ Telecom networking

■ Product Selection

Part Number	Operating Case temperature	DDMI
100G-Q-ER4	Commercial(0~70°C)	Yes

■ Regulatory Compliance

- ✓ ESD to the Electrical PINs: compatible with MIL-STD-883 Method 3015
- ✓ ESD to the Duplex LC Receptacle: compatible with EN 61000-4-2
- ✓ Immunity compatible with EN 61000-4-3
- ✓ EMI compatible with FCC Part 15 Class B
- ✓ Laser Eye Safety compatible with FDA 21CFR 1040.10 and 1040.11 IEC 60950, IEC60825-1,2
- ✓ RoHS compliant with RoHS 2.0(2015/863/EU)-amending.

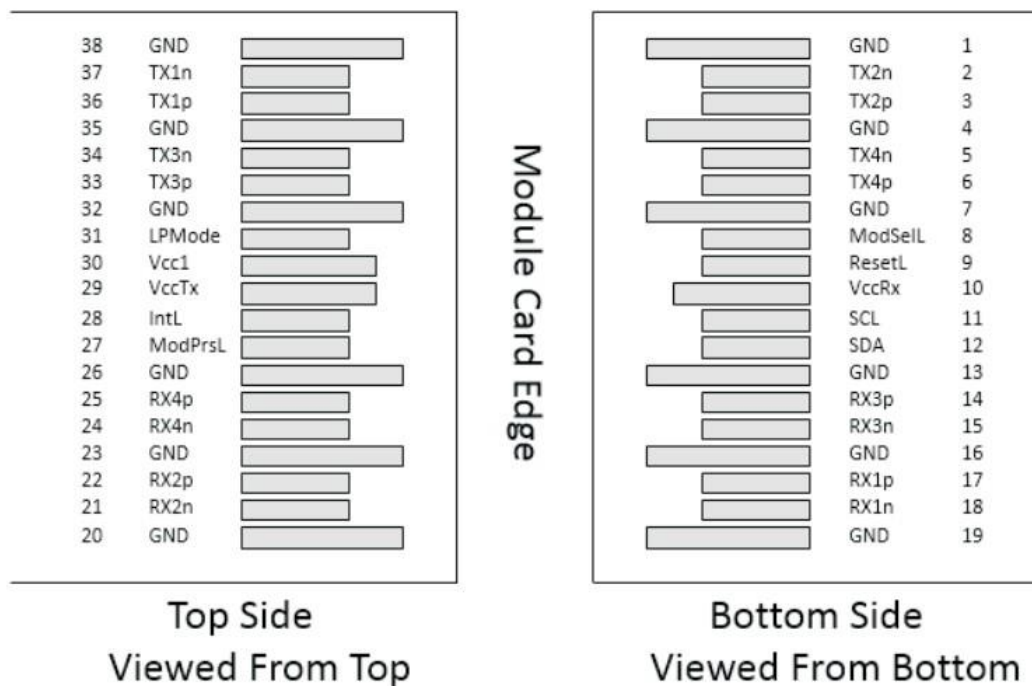
■ Pin Description

Pin	Symbol	Description	Notes
1	GND	Ground	1
2	Tx2n	Transmitter Inverted Data Input	
3	Tx2p	Transmitter Non-Inverted Data Input	
4	GND	Ground	1
5	Tx4n	Transmitter Inverted Data Input	
6	Tx4p	Transmitter Non-Inverted Data Input	
7	GND	Ground	1
8	ModSelL	Module Select	
9	ResetL	Module Reset	
10	Vcc Rx	+3.3V Power Supply Receiver	
11	SCL	2-wire serial interface clock	
12	SDA	2-wire serial interface data	
13	GND	Ground	1
14	Rx3p	Receiver Non-Inverted Data Output	
15	Rx3n	Receiver Inverted Data Output	
16	GND	Ground	1
17	Rx1p	Receiver Non-Inverted Data Output	
18	Rx1n	Receiver Inverted Data Output	
19	GND	Ground	1

20	GND	Ground	1
21	Rx2n	Receiver Inverted Data Output	
22	Rx2p	Receiver Non-Inverted Data Output	
23	GND	Ground	1
24	Rx4n	Receiver Non-Inverted Data Output	
25	Rx4p	Receiver Inverted Data Output	
26	GND	Ground	1
27	ModPrsL	Module Present	
28	IntL	Interrupt	
29	VccTx	+3.3V Power supply transmitter	
30	Vcc1	+3.3V Power supply	
31	LPMode	Low Power Mode	
32	GND	Ground	1
33	Tx3p	Transmitter Non-Inverted Data Input	
34	Tx3n	Transmitter Inverted Data Input	
35	GND	Ground	1
36	Tx1p	Transmitter Non-Inverted Data Input	
37	TxIn	Transmitter Inverted Data Input	
38	GND	Ground	1

Notes:

1. Circuit ground is internally isolated from chassis ground.



■ Transceiver Block Diagram

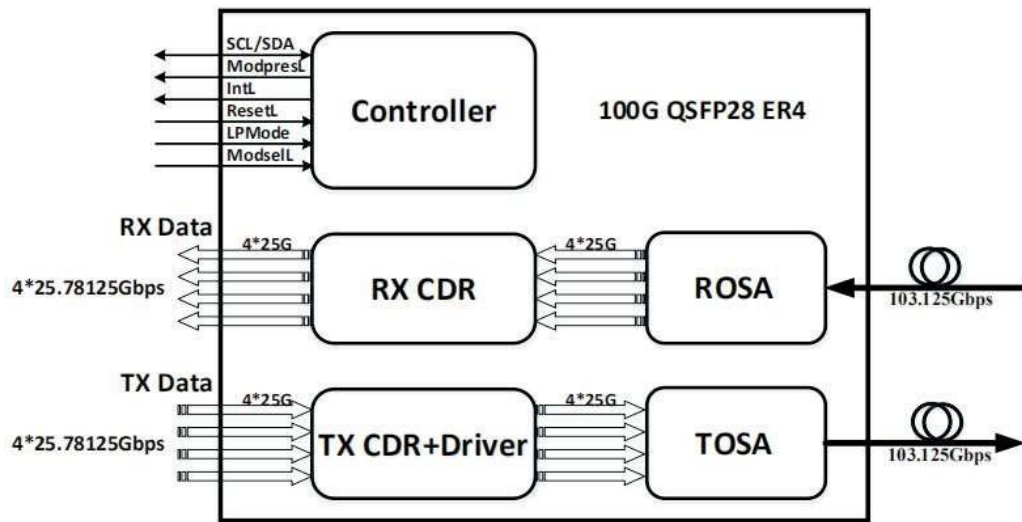


Figure 1. Transceiver Block Diagram

■ Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Units	Notes
Storage Temperature	T_S	-40	85	°C	
Maximum Supply Voltage	V_{CC}	0	3.6	V	
Operating Humidity	RH	5	85	%	
Damage Threshold, each Lane	TH_d	5.5		dBm	

■ Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Units
Case Operating Temperature	T_c	0		70	°C
Power Supply Voltage	V_{CC}	3.13	3.30	3.47	V
Power Supply Current	I_{cc}			1.443	A
Power dissipation	P			5	w
9/125um G.652 SMF	L_{max}			40	km

■ Electrical Characteristics

Parameter	Symbol	Min	Typical	Max	Units	Notes
Transmitter (each Lane)						

Data Rate, each lane			25.78125		Gbps	
Differential Input Voltage Swing Threshold	V _{pp}			900	mV	1
Common Mode Voltage	V _{cm}	-350		2850	mV	
Transition Time	Trise/Tfall	10			ps	
Differential Termination Resistance Mismatch				10	%	
Eye width	EW15	0.46			UI	
Eye height	Eh15	95			mV	
Receiver						
Data Rate, each lane				25.78125	Gbps	
Differential Termination Resistance Mismatch				10	%	1
Differential Output Voltage Swing	V _{out,pp}			900	mV	
Common Mode Noise, RMS	V _{rms}			17.5	mV	
Transition Time	Trise/Tfall	12			ps	2
Eye width	EW15	0.57			UI	
Eye height	Eh15	228			mV	

Notes:

1. At 1 MHz
2. 20%~80%

■ Optical Characteristics

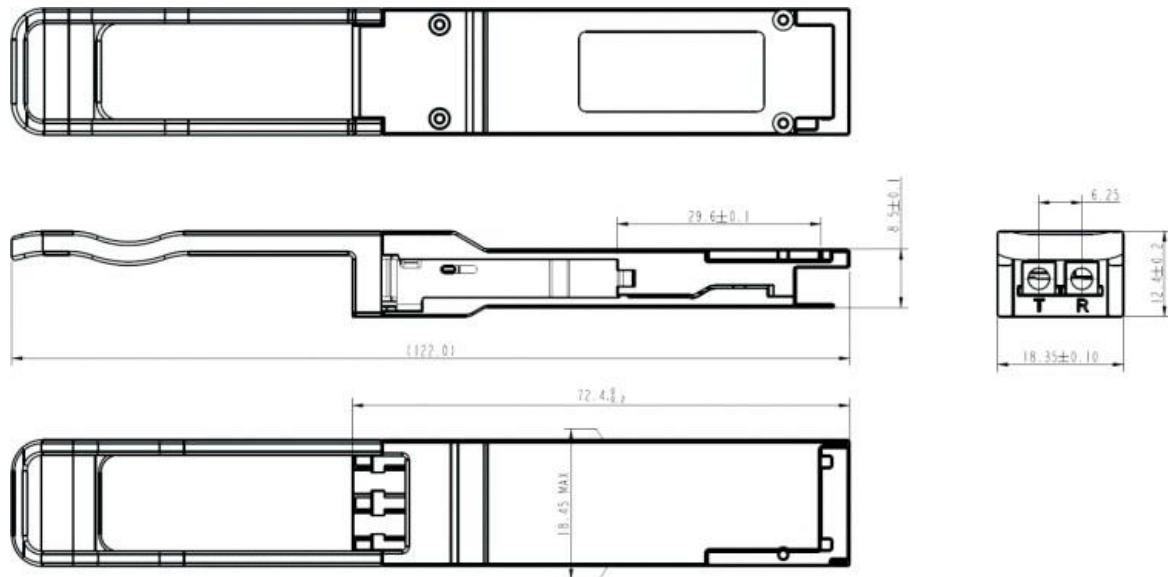
Parameter	Symbol	Min	Typical	Max	Unit	Notes
Lane Wavelength	L0	1294.53	1295.56	1296.59	nm	
	L1	1299.02	1300.05	1301.09	nm	
	L2	1303.54	1304.58	1305.63	nm	
	L3	1308.09	1309.14	1310.19	nm	
Transmitter						
Signalling Speed per Lane			25.78125±100ppm		Gb/s	
Side Mode Suppression Ratio	SMSR	30			dB	

Total Average Launch Power				8.9	dBm	
Average Launch Power, each Lane		-2.9		2.9	dBm	
OMA, each Lane		0.1		4.5	dBm	
Difference in Launch Power between any Two Lanes (OMA)				3.6	dB	
Transmitter and Dispersion Penalty (TDP), each Lane				2.5	dB	
Extinction Ratio	ER	8			dB	
RIN20 OMA				-130	dB/Hz	
Optical Return Loss Tolerance				20	dB	
Transmitter Reflectance				-12	dB	
Eye Mask{X1, X2, X3, Y1, Y2, Y3}		{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}				1
Optical Modulation Amplitude (OMA), each lane		5			%	1
Receiver						
Signalling Speed per Lane	Gbd		25.78125±100ppm		Gb/s	
Damage Threshold, each Lane		5.5			dBm	
Average Receiver Power, each Lane	SENS	-20.9		-3.5	dBm	
Receive Power (OMA), each Lane				-3.5	dBm	
Difference in Receive Power between any Two Lanes (OMA)				4.5		
Receiver reflectance				-26	dB	
Receiver sensitivity (AOP), each lane				-20.9	dBm	2
Receiver 3 dB electrical upper cut off frequency, each lane				31	Ghz	
LOS Assert	LOSA	-33			dBm	
LOS De-assert	LOSD			-22	dBm	
LOS Hysteresis	LOSH	0.5			dB	

Notes:

1. Hit ratio 5×10^{-5} .
2. Sensitivity is specified at BER@1E-12 without FEC.

■ Mechanical Dimesions



40G-Q-ER4

■ EEPROM Definitions

Lower Memory Map

Address	Type	Size	Name	Description	Value(Hex)	Remarks
0	R	1	Identifier	Identifier		
1	R	1	Status	Compliance Revision		
2	R	1	Status	Flat_mem/ IntL/Data_Not_Ready		
3	R	1	Interrupt Flags	Latched TX/RX LOS indicator		
4	R	1		Latched TX Adaptive EQ/TX Transmitter/Laser fault indicator		
5	R	1		Latched TX/RX CDR LOL indicator		
6	R	1		Latched temperature A/W/ Initialization complete flag		
7	R	1		Latched supply voltage A/W		
8	R	1		Vendor Specific		
9~10	R	2		Latched RX power A/W		
11~12	R	2		Latched TX bias A/W		
13~14	R	2		Latched TX power A/W		

15~18	R	4		Reserved		
19-21	R	2		Vendor Specific		
22-23	R	2	Device monitors	Module temperature		
24-25	R	2		Reserved		
26-27	R	2		Supply voltage		
28-29	R	2		Reserved		
30-33	R	4		Vendor Specific		
34-35	R	2	Power monitors	RX input power, channel 1		
36-37	R	2		RX input power, channel 2		
38-39	R	2		RX input power, channel 3		
40-41	R	2		RX input power, channel 4		
42-43	R	2	LD Bias Monitors	TX bias, channel 1		
44-45	R	2		TX bias, channel 2		
46-47	R	2		TX bias, channel 3		
48-49	R	2		TX bias, channel 4		
50-51	R	2	Power monitors	TX power, channel 1		
52-53	R	2		TX power, channel 2		
54-55	R	2		TX power, channel 3		
56-57	R	2		TX power, channel 4		
58-73	R	16		Reserved		
74-81	R	8		Vendor Specific		
82-85	R	4		Reserved		
86	RW	1	Control	Tx Disable		

87	RW	1		Rx_Rate_select		
88	RW	1		Tx_Rate_select		
89~92	RW	4		Rx_Application_Select		
93	RW	1		Power		
94~97	RW	4		Tx_Application_Select		
98	RW	1		TX/RX CDR_control		
99	RW	1		Reserved		
100-104	RW	4	Free Side Device and Channel Masks	Module and Channel Masks		
105	RW	1		Vendor Specific		
106	RW	1		Vendor Specific		
107	RW	1		Reserved		
108-109	R	2	Free Side Device Properties	Most significant byte of propagation delay		
110	R	1		Advanced Low Power Mode / Far Side Managed / Min Operating Voltage		
111-112	RW	2	Assigned for use by PCI Express	PCI		
113	R	1	Free Side Device Properties	End Implementation		
114-118	RW	6		Reserved		
119-122	W	4		Password Change Entry Area		
123-126	W	4		Password Entry Area		
127	RW	1		Page Select Byte		

Upper Memory Map Page 00h

Address	Type	Size	Name	Description	Value(Hex)	Remarks
128	R	1	Identifier	Identifier Type of serial Module		
129	R	1	Ext. Identifier	Extended Identifier to free side device. Includes power classes, CLEI codes, CDR capability		
130	R	1	Connector	Code for connector type		
131	R	1	Specification compliance	10/40G/100G Ethernet Compliance Codes		
132	R	1		SONET Compliance Codes		
133	R	1		SAS/SATA Compliance Codes		
134	R	1		Gigabit Ethernet Compliant Codes		
135~136	R	1		Fibre Channel link length/Fibre Channel Transmitter Technology		
137	R	1		Fibre Channel transmission media		
138	R	1		Fibre Channel Speed		
139	R	1	Encoding	Code for serial encoding algorithm.		
140	R	1		Nominal bit rate, units of 100Mbps. For BR>25.4G, set this to FFh and use Byte 222.		
141	R	1		QSFP+ Rate Select Version 2.		
142	R	1		Link length supported for SMF fiber in km.		
143	R	1	Length	Length(OM3 50 um)		
144	R	1		Length(OM2 50 um)		
145	R	1		Length(OM1 62.5 um)		
146	R	1		Length(OM5 50um)		
147	R	1	Device technology	Device technology		
148	R	1	Vendor name	Free side device vendor		
149	R	1				
150	R	1				
151	R	1				

152	R	1			
153	R	1			
154	R	1			
155	R	1			
156	R	1			
157	R	1			
158	R	1			
159	R	1			
160	R	1			
161	R	1			
162	R	1			
163	R	1			
164	R	1	Extended Module		
165~167	R	1	Vendor OUI		
168	R	1	Vendor PN	Part number provided by free side device vendor	
169	R	1			
170	R	1			
171	R	1			
172	R	1			
173	R	1			
174	R	1			
175	R	1			
176	R	1			
177	R	1			
178	R	1			
179	R	1			
180	R	1			
181	R	1			

182	R	1				
183	R	1				
184	R	1	Vendor rev	Revision level for part number provided by vendor		
185	R	1				
186	R	1	Wavelength	Nominal laser wavelength (wavelength=value/20 in nm)		
187	R	1				
188	R	1	Wavelength tolerance	Guaranteed range of laser wavelength(+/-value) from nominal wavelength. (wavelength Tol.=value/200 in nm)		
189	R	1				
190	R	1	Max case temp	Maximum case temperature in degrees C		
191	R	1	C_BASE	Check code for base ID fields		
192	R	1	Link codes	Extended Specification Compliance Codes		
193	R	1	Options	TXInput Equalization Auto Adaptive Capable not implemented, TX Input Equalization Fixed Programmable Settings implemented, RX Output Emphasis Fixed Programmable Settings implemented, RX Output Amplitude Fixed Programmable Settings implemented		
194	R	1		Tx CDR LOL Flag, Rx CDR LOL Flag, RX Squelch Disable, RX Output Disable, TX Squelch Disable, TX Squelch		
195	R	1		Memory page 02h implemented, Memory page 01h implemented, Active control of the select bits in the upper memory table is required to change rates, Tx_DISABLE and serial output		

				implemented, Tx_FAULT signal implemented, Tx Loss of signal implemented		
196	R	1	Vendor SN	Serial number provided by vendor		
197	R	1				
198	R	1				
199	R	1				
200	R	1				
201	R	1				
202	R	1				
203	R	1				
204	R	1				
205	R	1				
206	R	1				
207	R	1				
208	R	1				
209	R	1				
210	R	1				
211	R	1				
212	R	1	Date Code	Vendor's manufacturing date code		
213	R	1				
214	R	1				
215	R	1				
216	R	1				
217	R	1				
218	R	1				
219	R	1				
220	R	1	Diagnostic Monitoring Type	Average RX power measurement, Transmitter power measurement supported		
221	R	1	Enhanced Options	Indicates which optional enhanced features are implemented (if any) in the free side device.		

222	R	1	BR, nominal	Nominal bit rate per channel, units of 250Mbps.				
223	R	1	CC_EXT	Check Code for Address 192 to 222				
224	R	1	Vendor Specific					
225	R	1						
226	R	1	Vendor Specific					
227	R	1						
228	R	1						
229	R	1						
230	R	1						
231	R	1						
232	R	1						
233	R	1						
234	R	1						
235	R	1						
236	R	1						
237	R	1						
238	R	1						
239	R	1						
240	R	1						
241	R	1						
242	R	1						
243	R	1				Reserved		
244	R	1						
245	R	1						
246	R	1						
247	R	1						
248	R	1						
249	R	1						
250	R	1	Checksum					

251	R	1	Vendor Specific		
252	R	1			
253	R	1			
254	R	1			
255	R	1			

■ Digital Diagnostic Monitoring Interface

Five transceiver parameter values are monitored. The following table defines the monitor parameter's accuracy.

Parameter	Range	Accuracy	Calibration
Temperature	0 to +70°C	±3°C	Internal
Voltage	2.97 to 3.63V	±3%	Internal
Bias Current	0 to 100mA	±10%	Internal
Rx Power	-2.9 to +2.9dBm	±3dB	Internal
Tx Power	-20.9~-3.5dBm	±3dB	Internal